CLAIMS

We claim:

1. A programmable molecular device, comprising:

   at least one input lead;

   at least one output lead; and

   a nano-network spanning said input lead and said output lead, wherein said nano-network comprises a plurality of molecular circuit components.

2. The programmable molecular device according to claim 1 wherein said nano-network is self-assembled.

3. The programmable molecular device according to claim 1 wherein said nano-network is random.

4. The programmable molecular device according to claim 1 wherein said device is programmable by a self-adaptive algorithm for configuring said molecular circuit components.

5. The programmable molecular device according to claim 4 wherein said self-adaptive algorithm is selected from the group consisting of genetic algorithms, simulated annealing algorithms, go with the winner algorithms, temporal difference learning algorithms, reinforcement learning algorithms, and combinations thereof.

6. The programmable molecular device according to claim 4 wherein said molecular circuit components are configurable by applying a voltage across said input lead and said output lead.

7. The programmable molecular device according to claim 1 wherein said device is programmable to function as a logic unit.

8. The programmable molecular device according to claim 7 wherein said logic unit is selected from the group consisting of truth tables supported by said at least one input lead and said at least one output lead.

9. The programmable molecular device according to claim 8 wherein said logic unit is programmable to function as a device selected from the group consisting of an AND, an OR, an XOR, a NAND, a NOT, an Adder, a Half-adder, an Inverse Half-Adder, a Multiplexor, and a Decoder, and combinations thereof.

10. The programmable molecular device according to claim 1 wherein said device is programmable to function as a memory unit.

11. The programmable molecular device according to claim 1 wherein said device is reprogrammable.

12. The programmable molecular device according to claim 1 wherein said molecular circuit components are selected from the group consisting of molecular switches, molecular diodes, molecular wires, molecular rectifiers, resistors, transistors, molecular memory, and combinations thereof.

13. The programmable molecular device according to claim 12 wherein said molecular circuit components comprise molecular switches.

14. The programmable molecular device according to claim 13 wherein said device is programmable by an algorithm for setting said molecular switches.

15. The programmable molecular device according to claim 14 wherein said switches are settable by applying a voltage across said input lead and said output lead.

16. The programmable molecular device according to claim 1 wherein said nano-network further comprises nanoscale components.

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17. The programmable molecular device according to claim 16 wherein said nanoscale components are selected from the group consisting of nanotubes, nanoparticles, nanorods, and combinations thereof.

18. The programmable molecular device according to claim 17 wherein said nanoscale circuit components comprise nanoparticles and said molecular circuit components comprise molecular switches and said molecular switches interconnect said nanoparticles.

19. The programmable molecular device according to claim 18 wherein said nanoparticles are randomly arrayed.

20. The programmable molecular device according to claim 18 wherein said molecular switches randomly interconnect said nanoparticles.

21. A method of making an electronic component, comprising:

(a) providing a self-assembled nanocell; and

(b) programming the nanocell to function as the electronic component.

22. The method according to claim 21 wherein the nanocell comprises:

at least one input lead;

at least one output lead; and

a nano-network spanning the input lead and the output lead, wherein the nano-network comprises a plurality of molecular circuit components.

23. The method according to claim 22 wherein the molecular circuit components are selected from the group consisting of molecular switches, molecular diodes, molecular wires, molecular rectifiers, molecular resistors, molecular transistors, molecular memories and combinations thereof.

24. The method according to claim 23 wherein the molecular circuit components comprises molecular resonant tunneling diodes.

25. The method according to claim 24 wherein the molecular circuit components exhibit negative differential resistance.

26. The method according to claim 22 wherein the nano-network further comprises nanoscale components selected from the group consisting of nanotubes, nanoparticles, nanorods, and combinations thereof.

27. The method according to claim 22 wherein said nano-network is random.

28. The method according to claim 21 wherein step (b) comprises:

(b1) configuring the molecular circuit components.

29. The method according to claim 28 wherein step (b1) comprises:

(b1.i) adjusting a conductivity-affecting property of at least one of the molecular circuit components by applying a voltage across the input lead and the output lead.

30. The method according to claim 29 wherein the conductivity-affecting property is selected from the group consisting of charge, conformational state, electronic state, and combinations thereof.

31. The method according to claim 28 wherein step (b) further comprises:

(b2) testing the performance of the nanocell.

32. The method according to claim 31 wherein step (b) further comprises:

(b3) applying a self-adaptive algorithm to reconfigure the molecular circuit components.

33. The method according to claim 32 wherein the self-adaptive algorithm is selected from the group consisting of genetic algorithms, simulated annealing algorithms, go with the winner

algorithms, temporal difference learning learning algorithms, reinforcement learning algorithms, and combinations thereof.

34. The method according to claim 32 further comprising:

(b4) repeating steps (b2) and (b3) until the nanocell functions as the electronic component.

35. The method according to claim 22 wherein the electronic component comprises a logic unit.

36. The method according to claim 35 wherein the logic unit is selected from the group consisting of truth tables supported by the input leads and output leads.

37. The method according to claim 36 wherein the logic unit is selected from the group consisting of an AND, an OR, an XOR, a NOR, an NAND, a NOT, an Adder, a Half-Adder, an Inverse Half-Adder a Multiplexor, a Decoder, and combinations thereof.

38. The method according to claim 22 wherein the electronic component comprises a memory unit.

39. The method according to claim 22 wherein step (a) comprises:

(a1) allowing a plurality of nanoscale components to self-assemble into a random array;

(a2) allowing the plurality of molecular circuit components to self-assemble into a random molecular interconnect between the nanoscale components; and

(a3) bonding the molecular circuit components to the nanoscale components with molecular alligator clips.

40. The method according to claim 39 wherein the molecular alligator clips are selected from the group consisting of sulfur, oxygen, selenium, phosphorous, isonitrile, pyidine, carboxylate, and thiol moieties.

41. The method according to claim 39 wherein the nanoscale components are selected from the group consisting of nanotubes, nanoparticles, nanorods, and combinations thereof.

42. The method according to claim 39 wherein the molecular circuit components are selected from the group consisting of molecular switches, molecular diodes, molecular wires, molecular rectifiers, molecular resistors, molecular transistors and combinations thereof.

43. A molecular computer, comprising:

a plurality of programmable nanocells, each nanocell comprising:

a plurality of nanoparticles; and

a plurality of molecular diodes;

wherein said molecular diodes interconnect said nanoparticles; and

a plurality of metallic wires;

wherein said metallic wires interconnect said nanocells.

44. The molecular computer according to claim 43 wherein said nanocell is self-assembled.

45. The molecular computer according to claim 43 wherein said nanoparticles are randomly arrayed.

46. The molecular computer according to claim 43 wherein said molecular diodes randomly interconnect said nanoparticles.

47. The molecular computer according to claim 43 wherein each said nanocell comprises a linear dimension of up to about 2 microns.

48. The molecular computer according to claim 43 wherein at least one of said nanocells is programmable to function as a logic unit.

49. The molecular computer according to claim 48 wherein said logic unit is selected from the group consisting of truth tables supported by the wire interconnection.

50. The method according to claim 49 wherein at least one of said nanocells is programmable to function as a device selected from the group consisting of AND, OR, XOR, NOR, NAND, NOT, an Adder, a Half Adder, an Inverse Half Adder, a Multiplexor, a Decoder, and combinations thereof.

51. The molecular computer according to claim 43 wherein at least one of said nanocells is programmable to function as a memory unit.

52. The molecular computer according to claim 43 wherein said nanocell is programmable by an algorithm for configuring said nanocell's molecular diodes.

53. The molecular computer according to claim 43 wherein said said nanocell further comprises:

first and second leads; and

wherein said diodes are configurable by applying a voltage to said first and second leads.

54. The molecular computer according to claim 43 wherein at least one of said molecular diode exhibits negative differential resistance.

55. A method of making a computer, comprising:

(a) providing a plurality of trained self-assembled nanocells;

(b) interconnecting said trained nanocells to a plurality of untrained nanocells;

(c) allowing the trained nanocells to train the untrained nanocells.

56. The method according to claim 53, further comprising:

(d) hierarchically repeating steps (b) and (c).